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TRACTORS ON SOUTHERN FARMS.



WITHOUT DOUBT gas tractors can be used profitably on many southern farms, but they have not come into as general use in this section as in some other parts of the country, and southern farmers often do not have sufficient information to enable them to decide whether one will be profitable or what size and type will be best.

The experience of the 684 tractor owners in the States of Alabama, Georgia, North Carolina, South Carolina, and Tennessee, summarized in this bulletin, should help others in obtaining answers to their questions concerning the advantages and disadvantages of a tractor, the size required, length of life, cost of operation, kind, quantity, and quality of work done, and other pertinent questions.

TRACTORS ON SOUTHERN FARMS.

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TRACTORS were not introduced in any great numbers in the Southern States until their use had become general in other parts of the country. The crops raised, the systems of tenure under which the land is held, and the class of labor which has been generally available have all combined to retard the use of labor-saving farm machinery of all kinds in this area. Often the fields are so small or high terraces so numerous as to make difficult the use of large units of equipment.

Changing conditions during recent years, however, have led a considerable number of farmers in these States to place tractors on their farms. Many of these tractors have now been in use a sufficient length of time to enable their owners to determine the kinds of work which the tractors will do satisfactorily, the cost of operation, their effect on the operation and organization of the farms, and other points on which the man who is considering the purchase of a tractor should have information.

This bulletin summarizes the experience of 684 tractor owners in the States of Alabama, Georgia, North and South Carolina, and Tennessee. In February and March, 1921, a letter was addressed to each of several thousand men in these States who were known to own tractors asking for a report of the use which he was making of his tractor, for information from which the cost of operating the tractor could be determined, any changes in the size of the farm or number of work stock which had been made after the purchase of the tractor, the owner's idea of the profitableness of the machine, and other related information. Of the replies received all those concerning secondhand tractors, tractors which had been owned six months or

less, the comparatively few which had been purchased prior to 1918, and those which were used primarily for custom work were discarded. This left reports from 81 men in Alabama, 147 in Georgia, 134 in North Carolina, 75 in South Carolina, and 247 in Tennessee who owned tractors which had been purchased new, and which were used primarily for work on their own farms.

Most of the figures given are averages from these reports, and while the tractor owner should always endeavor to exceed the average performance, he must remember that the accomplishment of approximately half the men reporting was in every case below the average figures given. At least, the average figures are better guides as to what may be expected of a tractor under actual farm conditions than are the results of tests or performances with new tractors, operated by skilled men, under favorable conditions.

FARMS ON WHICH TRACTORS ARE OWNED.

The most striking point concerning the farms on which these tractors are owned is their large size as compared with other farms in the same States. The average size of the 684 farms is 290 acres, while the average size of all farms in these States, as determined by the 1920 census of agriculture, is only about 75 acres.

The average size of the farms where tractors are owned, and of all farms in the different States are as follows:

TABLE 1.—Average size of southern farms using tractors.

State.	Farms on which tractors are owned.	All farms (1920 census).
	<i>Acres.</i>	<i>Acres.</i>
Alabama.....	344	76
Georgia.....	318	82
North Carolina.....	205	74
South Carolina.....	315	64
Tennessee.....	293	77

The size of the farms in the different States from which reports were received are shown in Table 2. Thirty-five tractor owners failed to state the number of acres in their farms.

TABLE 2.—Size and number of farms of different sizes using tractors.

Size of farm (acres).	Number of farms—					
	Ala-bama.	Georgia.	North Carolina.	South Carolina.	Tennes-see.	Total.
Less than 75.....	6	4	19	6	8	43
75 to 174.....	27	53	51	25	65	221
175 to 274.....	15	37	31	18	68	169
275 to 374.....	7	11	9	8	41	76
375 to 574.....	11	19	10	5	34	79
575 and over.....	9	18	5	8	21	61

It is seen that more than 90 per cent of the farms on which tractors were owned are larger than the farm of average size in this section.

On most of the farms corn and cotton were the principal crops raised, but the proportion of the acreage devoted to these crops was slightly less than on all farms in these States as shown by the 1920 census of agriculture. On the Alabama, North Carolina, and Tennessee farms where tractors were owned, corn occupied a greater acreage than any other crop. In Georgia corn and cotton occupied the same acreage, and in South Carolina the acreage in cotton was considerably greater.

Table 3 shows the average number of crop-acres per farm and the proportion of this acreage devoted to different crops. A detailed report concerning the crops raised on his farm was not furnished by every tractor owner, but it is believed that the figures in the table are very nearly representative of the entire group.

TABLE 3.—*Proportion of acreage devoted to different crops.*

State.	Average crop-area.	Proportion of acreage.				
		Corn.	Cotton.	Hay.	Small grain.	Other crops.
	<i>Acres.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
Alabama.....	240	34	25	21	10	10
Georgia.....	255	32	31	9	15	13
North Carolina.....	147	28	19	16	24	13
South Carolina.....	238	26	44	10	15	5
Tennessee.....	197	36	5	25	22	12

SIZES OF TRACTORS.

Five hundred and twenty-four, or 76 per cent, of the 684 men own 2-plow tractors, and 135, or 20 per cent, own 3-plow machines. Thirteen men own the 1-plow size and 12 the 4-plow size. The number of tractors other than the 2-plow and 3-plow sizes is so small that in the following pages figures for only the two sizes are given.

The number of tractors of different sizes in the different States concerning which reports were received is shown in Table 4:

TABLE 4.—*Number of tractors of different sizes.*

State.	1-plow.	2-plow.	3-plow.	4-plow.
Alabama.....	1	62	15	3
Georgia.....		123	21	3
North Carolina.....	1	112	21	
South Carolina.....		50	24	1
Tennessee.....	11	177	54	5
Total.....	13	524	135	12

In general, the 2-plow tractors are used on smaller farms than are the 3-plow machines, the average size of all farms on which the 2-plow

tractors are owned being 262 acres, and where the 3-plow machines are owned 402 acres. Two-plow machines are owned on 82 per cent of the farms less than 175 acres in size, and on 73 per cent of the farms 175 acres and larger in size.

ADVANTAGES AND DISADVANTAGES.

There are certain advantages connected with the use of a tractor, and certain disadvantages. Just how great the different advantages and disadvantages are, however, and which ones should be given the greatest weight when endeavoring to decide whether or not to purchase a tractor are questions which a man who has not had experience with a machine can not answer. Each of these tractor owners was asked what he had found to be the greatest advantage of his tractor, and what he had found to be the greatest disadvantage. The answers are summarized below.

ADVANTAGES.

SAVING TIME AND LABOR.

A little over 400 men stated what they believed to be the greatest advantage, and nearly 50 per cent of them consider it to be the saving of time and labor effected by the tractor. The ability of the tractor to do a large amount of work in a short time, and the opportunity which it affords to perform field operations at the most opportune time, is considered to be the greatest advantage by a majority of the tractor owners not only in the South, but also in other sections of the country, and it seems that most farmers should give this advantage the greatest weight when deciding whether or not to purchase a machine.

Where the organization of the farm and the method of employing labor are such that hired labor, which would be necessary if the tractor were not used, can be dispensed with a considerable saving in expense for this item should result.

BETTER WORK.

After saving of time, the fact that the tractor does better work than can be done with horses and mules was cited most frequently as its greatest advantage by these southern farmers. Deeper and better plowing, and better preparation of the land after plowing, are often possible with the heavier tractor-drawn implements and the greater amount of power furnished by the tractor. This higher quality of work which can often be done at a more opportune time than would be possible with horses or mules is a valuable aid in securing maximum crop yields.

SAVING HORSES.

Relieving the work stock of hard work, especially in hot weather, and doing the work at a time when it would be difficult if not impos-

sible with horses and mules, was given as the greatest advantage of the tractor by about one-tenth of the owners.

REDUCTION OF EXPENSE.

Less than 5 per cent of the users consider that reduction of expense is the greatest advantage of the tractor. This, together with the fact that the cost of operation is given most often as the chief disadvantage connected with the use of a tractor, indicates that the introduction of a tractor will not often reduce to any great extent the expense of operating the farm.

BELT WORK.

The fact that the tractor is a convenient source of power for belt work was mentioned by approximately 15 per cent of these men as its greatest advantage. If there is a large amount of heavy belt work for which a tractor could be used satisfactorily, its ability to do such work in addition to drawbar work may be the deciding factor in determining whether or not one would be profitable.

DISADVANTAGES.

COST OF OPERATION.

The cost of operation, more than any other point, was emphasized as the great disadvantage of the tractor by these men. Some mentioned specifically the high cost of fuel and oil as compared with the low prices of farm products at the time their reports were made. Others stated that repair costs had been excessive, and others gave first importance to the depreciation of their machines.

LACK OF ADAPTABILITY.

Next after cost of operation the lack of adaptability of the present-day tractor to all of the work on southern farms is considered the greatest disadvantage. While the tractors owned by these men are especially well adapted to plowing and other heavy work of preparing the seed bed where fields are large and comparatively level, most of the machines can not be used satisfactorily for cultivating row crops; many of the owners stated that they could not use their machines with entire satisfaction in small or irregular-shaped fields; and others emphasized the difficulty of using their tractors on land which had been terraced.

MECHANICAL TROUBLE.

While mechanical trouble was not mentioned as often as the disadvantages listed above, a sufficient number mentioned mechanical difficulties and the lack of reliability as the principal disadvantage to warrant a warning to the prospective purchaser that he should be sure the machine he buys has proved reliable in the hands of

other farmers. It is probable that in many cases the mechanical difficulties are due at least in part to lack of ability on the part of the operator of the machine.

INCOMPETENT OPERATORS.

Probably a greater percentage of the tractor owners in the South than in other sections of the country depend upon hired help to operate their tractors, and such men often find it difficult to obtain competent operators. If a man who does not operate his own tractor can not find a reliable operator, repairs are likely to be high, and the machine may be out of order to such an extent that all the advantages connected with its use are overcome.

ARE THESE TRACTORS PROFITABLE?

The method of conducting the investigation was such that it was not feasible to obtain a detailed statement from each tractor owner as to the extent to which the cost of power and labor for operating his farm had been changed through the use of the tractor, but each farmer was asked whether or not he believed his machine would prove to be a profitable investment, with the thought that the replies to this question would give a good indication as to the profitableness of tractors in general. Eighty-six per cent stated that they believed their tractors were proving profitable.

A comparison of the reports of the men who were satisfied with their tractors with those from men who were dissatisfied showed that in some cases the failure to take advantage of the opportunity offered by the tractors to increase the acreage cultivated and reduce the number of work stock kept was probably responsible for the dissatisfaction; in other cases high operating costs or the poor service rendered by the tractor was responsible. Experience has shown over half the dissatisfied owners that their present tractors are not the proper size for their farms. (For full discussion of this point see pages 24-26.)

These reports were made in the spring of 1921 at a time when the prospects for a profitable crop year were not at all promising, and in order to determine whether these men were sufficiently well satisfied with their machines to use them in producing crops on which the profits would probably be very small they were asked whether they intended to use their machines during the season of 1921. Exactly 90 per cent replied that they would do so. Ninety-six per cent of those who believed their tractors would be profitable stated that they intended to use them in 1921, and only 52 per cent of those who did not believe they would prove profitable intended to use them that year.

THE BEST SIZE.

It is highly important that the tractor be of the proper size for the farm on which it is to be used and the work which it will be expected to do. A tractor owner may feel that his present machine will be profitable even though experience has led him to believe that some other size would be better for his conditions.

Six hundred and eleven of the 684 men reported the sizes which they now consider would be best for their farms, after having had experience with tractors, and 98, or 16 per cent of the total, now prefer sizes different from the ones they own. There had evidently been a tendency on the part of some to purchase machines which were too small for their needs, as only 16 of the 98 prefer smaller machines, while 82 prefer tractors larger than they now own.

Eighty-four per cent of those who own 2-plow tractors still prefer this size and 14 per cent prefer the 3-plow size. Eighty-eight per cent of those owning the 3-plow size still prefer it, while 8 per cent prefer the 2-plow size. Of the 611 who answered this question 12 prefer the 1-plow size, 404 the 2-plow, 176 the 3-plow, and 19 the 4-plow size or larger. (See title-page.) Thus, it would seem that, except under extraordinary conditions, a tractor for use in these States should be either the 2 or 3 plow size.

IS THE FARM LARGE ENOUGH?

The question as to whether a particular farm is large enough to warrant the purchase of a tractor is also important. In order to obtain information which would assist in answering this inquiry these experienced tractor owners were asked what they considered the smallest size of farm on which tractors the size of theirs could be used profitably.

Of course the organization, as well as the size, of a particular farm must be known in detail before one can say definitely whether a tractor would be profitable, but the opinions of these experienced men should be a general guide as to the minimum size of farm on which tractors of the kind and size they now own might be used profitably.

The average of the replies of the owners of the 2-plow machines was 92 acres and of the owners of the 3-plow machines 132 acres. In each case the replies of something like half of the men were above this average figure and the remainder below it.

It would seem that the man whose farm is much less than 90 acres in size would not be warranted in purchasing a 2-plow machine if he intended to use it primarily on his own place, nor would one whose farm was much less than 130 acres in size be warranted in purchasing a 3-plow machine. It must also be remembered that the

average sizes of the farms being operated were considerably larger than these figures, namely 262 acres for the 2-plow tractors and 402 acres for the 3-plow machines.

COST OF TRACTOR AND EQUIPMENT.

The average first cost of these tractors and the special machines which were purchased for use with them was approximately \$1,400. On many of the farms the cost of the tractor outfit was no doubt greater than the investment in all other machinery. On the average the first cost of the tractor alone, including freight, was \$1,050, the average cost of the 2-plow machines having been \$947, and of the 3-plow machines \$1,385. All of these tractors had been purchased in 1918, 1919, or 1920, and at present (April, 1922) the average prices of tractors of similar sizes and types are something like two-thirds of these figures.

Practically every farmer purchased a special plow for use with his tractor. Disk plows are used more commonly in this section than in any other part of the country, and 79 per cent of these farmers used disk plows with their machines, while the remainder used moldboard plows. The average cost of the 2-bottom disk plows was \$188 and of the 2-bottom moldboard plows \$155. The average cost of the 3-bottom disk plows was \$227 and of the 3-bottom moldboard plows \$228. For all farms the average cost of the tractor plow was \$191.

About 90 per cent of these men had purchased some other machinery in addition to plows for use with their tractors at an average cost of a little over \$200. Many had purchased heavy tandem disk harrows designed especially for tractor use, and a considerable number had added one or more belt machines to their equipment after purchasing their tractors. As in the case of the tractors, the cost of the plows and other equipment if purchased at the present time would be somewhat less than the figures shown.

LIFE AND DEPRECIATION.

In order to determine the number of years of service which tractors will give under southern conditions, and their rate of depreciation each man was asked to estimate the number of years of satisfactory service which he believed his tractor was capable of performing. While none of these tractors had been in use more than three years at the time the reports were made, and most of them were not nearly worn out, the average of the estimates gives the best available figure for the life of a tractor under actual farm conditions, and the first cost divided by the average life the best available approximation to the annual charge for depreciation.

According to the estimates the average life of all tractors would be 7.6 years, and the annual depreciation would be \$138. The estimated life of the 2-plow tractors was 7.4 years, and the annual depreciation \$128. The estimated life of the 3-plow tractors was 8.0 years, and the annual depreciation was \$173.

It must be remembered, of course, that the future life of a tractor, as of any other machine, depends not only upon its present condition and the probable amount of work which it will be required to do but also upon the care which it will be given and its owner's idea as to when it will be more profitable to discard it than to spend more time and money for repairs.

Those who gave unfavorable reports on their machines estimated the total life at an average of 5.1 years, while the men who gave favorable reports on their machines estimated their life at an average of 8 years. Thus it would seem that a prospective purchaser would be safe on counting on a minimum of 5 years' service from a tractor, and that one of good construction and workmanship, if given intelligent care and kept in repair, should last 8 years or more.

REPAIRS.

Since none of these tractors are nearly worn out the expense of repairs for them up to the time the reports were made does not give a true indication of the repair costs for the entire life of the machines. However, in order to determine the approximate repair costs during the early years of the machine's life each farmer was asked how much he had spent for repairs from the time of purchase to the time he made his report.

Nearly one-third of those who had owned their machines one year or less had had no expense for repairs. Some of the others had had heavy repair charges, however, so that the average repair costs on all 2-plow machines which had been owned one year or less was \$28, and on all 3-plow machines, \$21. There had been no repair costs on a little less than 10 per cent of the machines which had been in use between one and two years. The average repair costs on all 2-plow machines in this age group had been \$48, and on 3-plow machines \$65.

Eighty-seven owners of 2-plow machines which had been in use between two and three years reported an average repair charge of \$87 to date, and 22 owners of 3-plow machines of the same age reported an average repair charge of \$111.

These older machines had been in use approximately two and one-half years on the average, and thus the average annual repair costs had been about \$35 for the 2-plow machines and \$44 for the 3-plow machines. It is apparent, however, that these figures are too low for the annual repair charges covering the entire life of the machines,

and in the computation of the cost of using these tractors on page 15 the average annual repair charges have been assumed to be 4 per cent of the reported first cost; that is, \$38 per year for the 2-plow tractors and \$55 for the 3-plow tractors.

In order to determine the character of the service which the tractor owners in this section could expect from the manufacturer or the dealer, these men were asked to report the amount of time which they had lost on account of inability to obtain repairs when needed, and the character of the work done by expert repair men. About 60 per cent of them stated that they had suffered no delays while waiting for repair parts, but the remaining 40 per cent had lost an average of about nine days on this account since their machines were purchased.

Since tractors did not come into general use in the Southern States until a comparatively late date, some manufacturers and dealers are evidently not so well equipped to furnish repairs and service on their machines as they are in other parts of the country.

About two-thirds of the entire number had utilized the services of an expert repair man at least once, and in about 85 per cent of the cases the owners considered that the work of the experts had been satisfactory.

A prospective purchaser will want to guard against the possible loss of several days time during the busy season, and the troubles due to poor work of so-called expert repair men, consequently he should satisfy himself that he will always be able to obtain without delay any needed repairs for the tractor which he intends to purchase, and that a competent repair man will be available if needed.

DAYS USED ANNUALLY.

The number of days work which a particular tractor will do in a year depends in a large measure upon the system of farming followed, the size of the farm, and the particular operations for which the owner uses his machine. The prospective purchaser will desire to know, however, about how many day's work per year he should expect his tractor to do, and these tractor owners were asked for their estimate of the total number of full day's work done per year by their machines. The average of the estimates was 53 days.

As would be expected, those who were operating larger farms use their tractors a somewhat greater number of days per year than those who used them on the smaller farms. The men whose farms were less than 175 acres in size estimated that they used their tractors on an average 48 days per year, and those whose farms contained 175 acres or more estimated that they used their machines 56 days per year.

The average size of the farms on which the 2-plow tractors are owned is less than those upon which the 3-plow tractors are owned, and while the 3-plow machines do more work per day than the smaller ones the owners of the 2-plow tractors estimated that they used them only 52 days annually, while the owners of the 3-plow machines estimated they used them 56 days.

The life of a tractor depends to a certain extent upon the amount of work it does. Machines which do the least amount of work per year, should, in general, have the longest life in years. As stated above the estimated life of all these tractors was 7.6 years, and if they do 53 days work per year they will do about 400 full days work during life. While the tractor of high class workmanship, which is always run by a skilled operator, would no doubt have a longer useful life than this, the prospective purchaser should not often count on being able to obtain more than 400 full days work from his machine.

WORK WHICH TRACTORS DO.

While all of these machines are used primarily for work on the home farm, approximately 50 per cent of the owners stated that they did some custom work with their tractors. This custom work, however, usually amounted to only a few days per year, and over 90 per cent of the time the tractors were used during the year covered by the reports was spent on the home farm.

Drawbar work constituted approximately 80 per cent of the work on the home farm and belt work the remaining 20 per cent. The tractors were used more for plowing than for any other one operation. For all farms the drawbar work was divided approximately equally between plowing and all other drawbar work, most of which consisted of disking and other work in preparing the seed bed.

On most farms this work of plowing and fitting ground required more time and labor than the other operations, and it is for such work that the tractor is usually most suitable. There may be some question as to whether or not a tractor can be used satisfactorily for the work of fitting the ground after plowing on account of danger of packing the soil and possible inability of the machine to obtain traction. Most of the men are evidently finding the machine which they own satisfactory for such work. (Fig. 1.) A large majority of the tractors have been used for some work on plowed ground, and over 90 per cent of the owners stated that they considered their machines satisfactory for such work.

A considerable number reported that they used their tractors for pulling binders in grain harvest, but where such work was done with

the tractor it amounted to only about four or five days per year. About one-fifth of the men also used their tractors for hauling on the road. However, unless very heavy loads are to be hauled comparatively short distances, some other form of power will usually be found preferable for this work.

The men were not asked for a report as to the specific belt operations for which they used their tractors, but, in order to determine whether or not they were finding it possible to use their tractors for belt work which they formerly hired done, each owner was asked to give an estimate of the number of days of belt work now done annu-

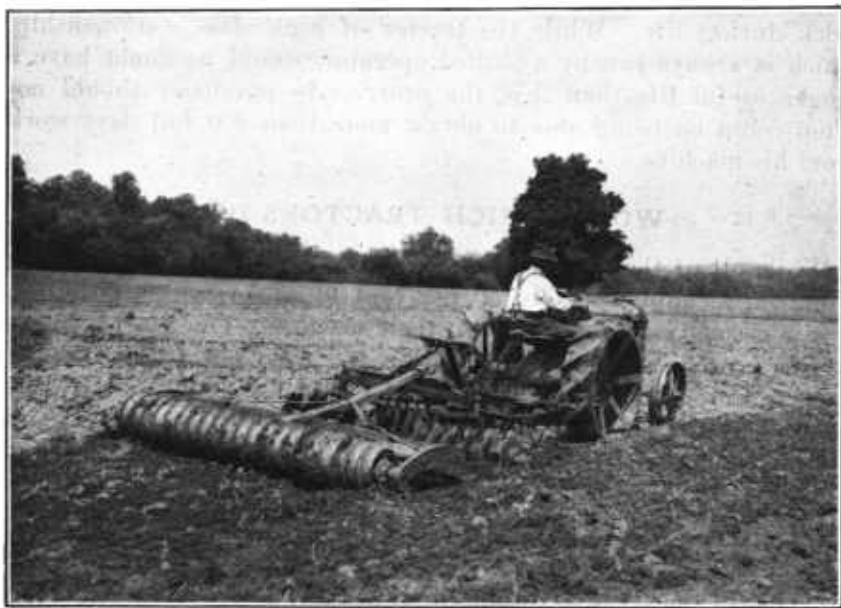


FIG. 1.—The tractors have proved satisfactory for disking and other work on plowed ground.

ally with his tractor which was formerly done with a hired engine. Four hundred and seventy-six of the 684 men replied to this question, and the average of the replies was 13 days. One hundred and three, or a little over 20 per cent of the 476, however, said that they do not use their tractors for any belt work which they formerly hired done.

The replies showed that the 2-plow tractors saved the hire of an engine for 12 days annually and the 3-plow machines for 16 days. The average size of the farms on which the 2-plow machines were owned was 262 acres and the 3-plow 402 acres, and there probably was a considerably greater amount of belt work to be done on the larger farms. Also in some cases the lighter 2-plow machines did not have sufficient power for part of the belt work, and the owners

of such machines may find it necessary to hire engines to a greater extent than will the owners of more powerful tractors.

WORK DONE PER DAY.

A large majority of tractor owners use their machines for plowing, and 519 owners of the 2-plow machines and 131 owners of the 3-plow machines gave statements of the average number of acres covered per day at this operation. As stated on page 10 about four-fifths of the plows used with the tractors were disk plows, and on account of their narrower width as compared with moldboard plows the acreage covered per day with such plows was somewhat less than that covered by moldboard plows with the same number of bottoms.

On the average the 2-bottom disk plows covered 4.7 acres per day and the 2-bottom moldboard 5.3 acres, the 3-bottom disk plows 6.5 acres, and the 3-bottom moldboard plows 7.3 acres. Thus, for each size, the moldboard plows covered about one-eighth more ground per day than did the disk plows. When plowing, they were in the field an average of a little less than 10 hours per day.

A comparison of these figures with those determined in investigations of the use of tractors in other parts of the country show that the tractors in the South do not cover quite as great an acreage per day in plowing as do machines of corresponding size in other areas. However, the reduction in the amount of labor required for plowing below that required for plowing with the horse outfits commonly used is at least as great on these southern farms as in any other part of the country. On very few farms in these States are teams of more than two horses or mules used for plowing, and in many cases only one-horse plows are used. A two-horse plow will rarely cover more than 2 acres in a 10-hour day, which is less than one-half of the average acreage covered by the 2-plow tractors and less than one-third of the acreage covered by the 3-plow outfits.

While no information was obtained as to the amount of work done per day with the tractors at field operations other than plowing, the saving of time effected through their use should be approximately as great as when plowing with implements which provide a full load are used.

In addition to covering a much greater acreage, the tractors have also made it possible for these men to plow to a considerably greater depth than they did before purchasing their tractors. While every man did not increase the depth of his plowing, the average depth to which they plowed with horses before purchasing their tractors was between $5\frac{1}{2}$ and $5\frac{3}{4}$ inches, and with their tractors they plow to an average depth of $8\frac{3}{4}$ inches.

FUEL REQUIREMENTS.

The 2-plow tractors use an average of about 17 gallons of fuel per day for plowing and the 3-plow tractors about 21 gallons. About 80 per cent of the 3-plow machines and about 70 per cent of the 2-plow machines were operated on kerosene, but inasmuch as the kind of fuel used makes little difference in the amount required per day and per acre, the averages above are for the kerosene and gasoline-burning tractors combined. In addition, however, the kerosene tractors used an average of about a half gallon of gasoline per day for starting and warming up.

There is practically no difference in the amounts of fuel used per day by tractors of the same size pulling disk and moldboard plows, but the greater number of acres covered per day with the moldboard plows makes the average number of gallons per acre less when using the moldboard plows than when using disk plows. The average requirements per acre for the two sizes and the two kinds of plows are as follows:

	Gallons.
2-bottom disk plow.....	3.7
2-bottom moldboard plow.....	3.1
3-bottom disk plow.....	3.3
3-bottom moldboard plow.....	2.9

While these figures are somewhat higher than those usually given by manufacturers and others for the amount of fuel required to plow an acre, it must be remembered that the average depth of the plowing is $8\frac{3}{4}$ inches, and that much of the soil in the South is heavy. Furthermore the disk plows commonly used do not turn as wide a furrow as the moldboard plows used with the same tractors in other sections, and consequently more time and travel is necessary to cover a given acreage.

While a careful operator, with a machine which is in perfect adjustment, may be able to plow with less fuel than this the prospective purchaser would not be justified in expecting to be able to do heavy plowing at all times during the life of his tractor with an average fuel consumption much less than that given above.

No figures were obtained upon the amount of fuel used at operations other than plowing, but investigations made in other parts of the country, have shown that when a tractor is pulling a full load either on the drawbar or on the belt the amount of fuel used per day is very nearly the same as when plowing.

LUBRICATING OIL.

The 2-plow tractors use an average of 4 quarts of lubricating oil per day and the 3-plow tractors $4\frac{1}{2}$ quarts. On the basis of the acreage covered per day as given on page 15, this makes an average

of 0.8 quart per acre when plowing with the 2-plow tractors, and 0.7 quart with the 3-plow tractors. As was the case with fuel, the amount used per acre was slightly greater for each size when pulling disk plows than when pulling moldboard plows. The reports of the amounts of oil used daily varied considerably for tractors of the same size, depending somewhat upon the construction of the machine, the quality of oil used, and the owner's idea of what constitutes proper lubrication. Also kerosene-burning tractors often require more oil than gasoline-burning machines.

Ordinarily it would be better to supply too much oil than to risk the serious damage which is likely to result if too little oil is used, and the prospective customer should consider the amounts given above as practically the minimum for the best operation of most types of machines.

COST OF OPERATION.

TABLE 5.—Average cost per acre of using 2-plow and 3-plow tractors (with disk and moldboard plows) for plowing in 1920.

Kind and size of plow.	Depreciation.	Repairs.	Interest.	Fuel.		Oil.	Total.	
				Gasoline.	Kerosene.		For gasoline tractors.	For kerosene tractors.
2-plow, disk.....	\$0.53	\$0.16	\$0.18	\$1.14	\$0.78	\$0.17	\$2.18	\$1.82
2-plow, moldboard.....	.45	.13	.15	.95	.65	.16	1.84	1.54
2-plow, all.....	.51	.15	.17	1.07	.73	.17	2.07	1.73
3-plow, disk.....	.47	.15	.17	1.01	.69	.16	1.96	1.64
3-plow, moldboard.....	.46	.14	.16	.89	.62	.11	1.76	1.49
3-plow, all.....	.46	.15	.16	.98	.67	.15	1.90	1.59

Table 5 above gives the average cost per acre of using the 2-plow and 3-plow tractors for plowing during 1920. Only the items of depreciation, repairs, interest, fuel, and oil are included. The total of all other items of cost, such as labor of the operator in repairing the tractor, the grease, housing, taxes, and insurance would amount on the average to only a small part of the total cost, and for very few tractors would it be more than 10 per cent of the total of the items included in the table.

On account of lower prices, both of the tractors themselves and of fuel and oil, the cost of using tractors of similar sizes and types purchased at the present time (April, 1922) would be considerably less than the costs on these farms in 1920.

Separate figures are given for disk and moldboard plows, and for gasoline and kerosene burning machines. The higher costs shown for the disk plows in every case are due to the fact that the width of cut of the disk plows is less than that of the moldboard plows and consequently more time and travel is necessary to cover a given acreage.

It must be remembered that the figures represent only the cost of using the tractor, and that the costs for man labor, and for the plows used must be added to these figures to obtain the total cost of plowing with the tractors.

DEPRECIATION.

The depreciation charge per day has been determined by dividing the reported first cost of the machines by the estimated life, and this in turn by the number of days used annually. This depreciation charge per day was divided by the number of acres covered per day in plowing to obtain the figures given in the table.

REPAIRS.

As stated on page 11 the repair costs have been computed on the basis of an annual repair charge of 4 per cent of the reported first cost of the machines, that is, \$38 for the 2-plow tractors and \$55 for the 3-plow outfits.

INTEREST.

Interest has been charged at 8 per cent annually on the average investment. The average investment has been found by the formula: First cost multiplied by the years of service plus 1, divided by the years of service multiplied by 2. This charge amounts to \$43 per year for the 2-plow machines and \$62 for the 3-plow machines. The annual charges for both repairs and interest have been divided by the number of days used annually, and the acres covered per day, to obtain the figures in the table.

FUEL.

Gasoline cost 30.7 cents per gallon on the average and kerosene 20.4 cents during the year covered by the reports. The cost per acre for fuel as given in the table was based on these prices and the amount used per acre by the two sizes when pulling disk and mold-board plows. The cost of fuel for the kerosene-burning tractors includes the cost of a half gallon of gasoline daily for starting and warming up, which amounts to about 2 cents per acre.

LUBRICATING OIL.

The average price paid for lubricating oil during the year was 85 cents per gallon, and the amount used per acre as given on page 16 was approximately 0.8 quart for the 2-plow machines, and 0.7 quart for the 3-plow machines.

The cost of using a particular tractor for plowing differs from these average figures in proportion to the difference between the sizes of the different items of cost for that machine and the average size of the items as given in the table. While an individual owner, or prospective purchaser, would not be justified in using these figures

as they stand as representing the cost of plowing with a tractor on his farm under present conditions, they do give an idea of the relative importance of the different items of cost, and the methods used in computing them.

MAN LABOR SAVED.

Since work can be done more quickly with a tractor than with the teams ordinarily used in this section, and since a great many of these men consider the saving of time effected by a tractor as the greatest advantage connected with its use, it is to be expected that the amount of man labor used in the operation of these farms on which tractors are owned will now be considerably less than it was before their purchase.

In order to determine as exactly as possible just how much labor these tractors were saving, each owner was asked to state the number of days of labor he saved annually through the use of the tractor. Three hundred sixty-five of the 684 men answered this question, and the average of their replies was 66 days. Seven men, about 2 per cent of the 365, however, said that their tractors did not save any man labor. The average tractor was used 53 days per year, and about 75 per cent of this time, or between 35 and 40 days, was consumed by drawbar work on the home farm (p. 13.) Thus the figures show that the average tractor saved from one and one-half to two days of labor for every day it was used for drawbar work.

The tractors on the smaller farms were not used as many days as those on the larger farms, and the amount of labor saved on the smaller farms is correspondingly less. The men who were operating farms of less than 175 acres in size stated that their machines saved about 57 days of man labor per year, and those on farms of 175 acres and over gave an average of 72 days of man labor saved.

The average size of the farm on which the 3-plow tractors were owned was somewhat greater than those on which the 2-plow machines were owned, and this, together with the greater amount of work done per day by the larger size, makes the amount of man labor saved annually by the 3-plow tractor greater than that saved by the 2-plow machines. The average of the reports of the owners of the 2-plow tractors was 63 days, and of the 3-plow tractors 78 days.

The figures given do not necessarily mean that the tractor owners reduced the amount of hired help used by the amounts shown, but are simply the amounts of additional time which would be required per year if the work which is now done with tractors was done with horses or mules. The amount by which a tractor owner can reduce his expense for hired help will depend largely upon the system of

farming which he follows, and the methods used in employing labor. It seems, however, that if a tractor owner can not reduce his expense for hired help the use of the machine should nearly always make possible either the doing of more and better work on the land already under cultivation or enable its owner to increase his acreage without employing additional labor.

INCREASE IN SIZE OF FARM.

These men were asked whether or not they farmed a greater acreage than before they purchased their tractors. Five hundred twenty-eight of the 684 answered the question, and 47 per cent of this number stated that they had increased their acreage. The percentage was greatest in North Carolina, where 71 per cent had increased the size of their farms, and least in South Carolina, where only 33 per cent were farming larger acreages than before purchasing their tractors. The amounts of additional land which the individual men were farming varied from only a few acres to several hundred acres, but the average increase had been 50 acres.

As a rule, it was the men on the smaller farms who had increased their acreage. One hundred seventy-nine men who had taken on more land and who reported in detail concerning it had been farming only 209 acres before the purchase of their tractors, while 223 men who had not taken on additional land were farming an average of 322 acres.

While many factors other than the purchase of a tractor must be considered when an increase in acreage is contemplated, the addition of a tractor to the farm equipment often makes possible the farming of a considerably greater acreage without increasing the number of work stock kept or the amount of hired labor used.

REDUCTION IN WORK STOCK.

The number of work stock which must be kept after the purchase of a tractor is the number required for the operations which the tractor will not do satisfactorily and economically. Tractors are especially adapted to the work of plowing and preparing the seed bed, and on farms where this work determines the number of work stock the purchase of a tractor should nearly always make possible some reduction. On many southern farms, however, especially where cotton and corn are the principal crops, the peak of horse labor comes at cultivating time. Since most of the tractors in use there are not suitable for cultivating row crops the addition of a tractor to the equipment of such a farm can not be expected to result in a reduction in the number of work stock.

Figure 2 shows by 10-day periods the distribution of the horse labor for field work on an Alabama farm with 90 acres of corn, 80 acres of cotton, 45 acres of hay, 30 acres of oats, and 11 acres of beans. It is seen that practically as much horse labor was used during the latter part of May, when corn and cotton cultivation was at its height, as in any period during the planting season.

The replies from 223 tractor owners who had not increased the size of their farms indicate that the average reduction in number of work stock was from 8.8 to 7.4 head. The average size of these

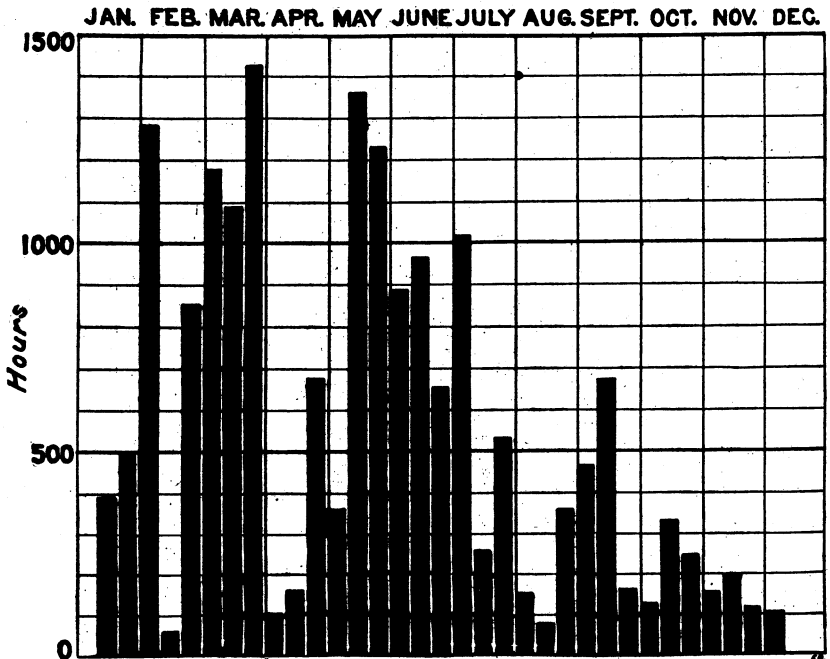


FIG. 2.—Distribution of horse labor by 10-day periods on a farm in Alabama, adapted from records of the Office of Farm Management and Farm Economics.

farms was 322 acres, and before the purchase of the tractor one head had been kept for each 36 acres, while at the time of reporting there was one head for each 44 acres. However, 101, or nearly half, of the men had not reduced their work stock. They were farming an average of 401 acres, and were keeping one head for each 41 acres. The 122 who had reduced their work stock were farming an average of 256 acres. They had been keeping one head for each 32 acres before the purchase of their tractors, and were keeping one head for each 47 acres at the time of reporting. On these farms there has been an average reduction of 2.6 head per farm.

The men who had reduced their work stock had been keeping a greater number in proportion to the size of their farms before they

purchased their tractors than those who did not make any reduction in their work stock, but at the time of reporting they were keeping appreciably fewer than those who had made no change. Thus, it would seem that at least part of the men who had not made any change in their work stock were still keeping more than they needed.

One hundred seventy-nine men who had increased the size of their farms had been farming 209 acres, and keeping an average of 6.7 head; that is, one head for each 31 acres, before purchasing their tractors. At the time of reporting they were farming 256 acres and keeping 5.1 head of work stock, or one head for each 50 acres. Thus they had increased their acreage by about 20 per cent, and at the same time reduced the number of work stock by nearly 25 per cent. They were keeping a smaller number in proportion to the size of their farms than were those who had not increased their acreage.

Seventy-two of the 179 men had not changed the number of their work stock. They had increased the size of their farms from 198 acres to 240 acres. They had had 37 acres for each head of work stock before purchasing their tractors, and had 45 acres for each head at the time of reporting.

RELIABILITY.

The reliability of a tractor, as of any other farm machine, determines to a large extent its profitableness. A machine which is out of running order for several days at a time when its services are needed can scarcely be considered a profitable investment. Practically all of the tractors now on the market will give reliable service if kept in repair and operated carefully, and a considerable part of the serious delay which tractor owners experience is due to negligence or lack of ability on the part of the operator.

These men were asked how many days during the year preceding the time of reporting their tractors had been out of running order when needed. Of those who answered the question 48 per cent reported that their machines had not been out of order at all, while the remaining 52 per cent reported an average loss of seven days during the year.

A part of this loss had evidently been due to inability to obtain repair parts when needed, as nearly 40 per cent of the men reported some idleness due to this cause. The average number of days lost by this 40 per cent from the date of purchase to the time of reporting had been nine (p. 12).

Minor delays while in the field with the tractor are often caused by parts getting out of adjustment, difficulties in starting, or the breakage of minor parts. Such delays are usually not so serious

as those due to the tractor being entirely out of running order, but nevertheless they are very annoying, and may cause a considerable loss of time. Five hundred seventy-one reported the amount of time lost per day while plowing. One hundred twelve stated that there had been no appreciable loss, and the remaining 459 reported an average loss of three-fourths hour per day. Doubtless most of these minor delays could have been avoided by more careful attention to the tractor by the operator.

As a rule hired men do not obtain as satisfactory results as the tractors owners themselves, and it is probable that the percentage of tractor owners who employ hired help to operate their tractors is greater in the South than in most other sections of the country. Thirty-five per cent of the machines were usually operated by hired help, and only about 50 per cent of the owners stated that their machines were always operated by the same person. This use of hired help, and the changing of operators was doubtless responsible for a part of the lost time.

Automobiles are owned on about 85 per cent of these farms and nearly 65 per cent reported the ownership of stationary or portable gasoline engines. Thus most of the owners had at least a general knowledge of the operation of internal combustion engines. But more than a superficial knowledge of gas-engine operation is necessary if a tractor is to be kept in condition to pull loads requiring its maximum power day after day. The operator must be able to detect trouble as soon as it begins to develop and remedy it promptly instead of allowing it to run along until a serious delay results.

QUALITY OF WORK.

Ninety-one per cent of the men state that the plowing which they do with their tractors is better than that done with horses and mules, and only 2 per cent state that it is poorer. A considerable number also state that the better work which they do with their tractors is the principal advantage connected with their use. This would indicate that tractors are capable of doing better work, especially in plowing and fitting ground, than is done on most southern farms where horses and mules furnish the power.

It must be remembered, however, that the quality of work which the tractor does depends almost entirely upon the implements used with it, and the fact that the quality of work done with the tractors is better than with animals is due not only to the large amount of power furnished by the tractors, but also to the heavier and sturdier implements used. The horse-drawn field implements used on most southern farms are as a rule considerably lighter than those used in any other section of the country (Fig. 3), and the percentage of southern tractor

owners who say that they do better work with their tractors and tractor implements is greater than the percentage in other sections of the country.

A considerable part of the increase in the quality of the plowing done is probably due to the greater depth of plowing which the tractors make possible. As stated on page 15 these men increased the average depth of plowing from a little over $5\frac{1}{2}$ inches to about $8\frac{3}{4}$ inches.

The tractors on these southern farms have also proved quite satisfactory for disking and other work on plowed ground. Nearly all of



FIG. 3.—A typical southern plowing scene. One mule and a 7 or 8 inch plow.

the men reported using their tractors for some such work, and 92 per cent of the total have found that their tractors can be used satisfactorily for such work.

Tractor-drawn disk harrows are, as a rule, considerably heavier than the horse-drawn disks used in this section, and if there is no danger of packing plowed ground with the tractor the quality of the disking should be considerably better than that done with horses and mules.

WHY SOME TRACTORS ARE UNPROFITABLE.

The reports of those who did not believe that their machines were proving profitable were studied in an effort to determine as far as possible the causes of their dissatisfaction.

Table 6 compares their reports with those of the satisfied owners.

TABLE 6.—*Profitable and unprofitable tractors.*

[Averages from 676 reports.]

	Profit- able.	Unprofit- able.
Number of reports.....	578	98
Months tractor had been owned.....	18	19
Farmers who own 2-plow tractors..... per cent..	77	74
First cost of tractor.....	\$1,040	\$1,120
Repair costs since purchase.....	\$33	\$150
Estimated life..... years..	8.0	5.1
Fuel per acre for plowing..... gallons..	3.3	4.0
Time tractor was out of running order during year..... days..	2.1	13.6
Time per day lost on account of trouble..... hours..	0.4	1.6
Tractors operated by hired help..... per cent..	33	44
Farmers who think quality of plowing done by tractor is better than that done by horses..... per cent..	94	74
Farmers who consider the tractor satisfactory for work on plowed ground..... do.....	97	58
Time tractors are used per year..... days..	55	38
Man labor saved annually..... do.....	70	33
Belt work formerly done by hired engine..... do.....	13	8
Farmers who increased acreage after purchase of tractor..... per cent..	55	7
Reduction in work stock..... head..	1.8	0.6
Farmers who believe present tractors are most suitable size for their farms..... per cent..	89	48

The man who is considering the purchase of a tractor should study these figures and endeavor to make sure before purchasing a machine that his experience will be different from that of the 98 dissatisfied owners whose reports are summarized in the table.

COST OF OPERATION.

The satisfied men had owned their machines approximately the same length of time as the dissatisfied ones; the average first cost had not been very different for the two classes, and approximately three-fourths of each class owned 2-plow machines. However, the dissatisfied owners had on an average repair costs of \$150 each, nearly five times as much as the satisfied owners. The estimated life of the unprofitable tractors was only 5 years, while that of the profitable machines was 8 years, and the unprofitable machines were using over 20 per cent more fuel than the profitable ones.

RELIABILITY.

The unprofitable tractors were out of running order during the year covered by the reports six times as long as the profitable ones. The satisfied owners lost less than half an hour per day while in the field, and the dissatisfied owners lost more than 1½ hours.

The operators were very probably responsible for a considerable part of this great difference in the cost of operation and reliability. While some breakage and delay is almost unavoidable, a careful and proficient operator can do much toward insuring low repairs, depreciation, and fuel consumption, and will keep his tractor in such condition that the loss of time when using it will be reduced to the minimum.

QUALITY OF WORK.

Ninety-four per cent of the satisfied owners and only 74 per cent of the dissatisfied owners do better plowing with their tractors than with horses and mules. Nearly all of the satisfied owners, but only a little more than half of the dissatisfied owners, have found their tractors suitable for work on plowed ground.

DAYS USED ANNUALLY.

The profitable tractors did nearly 50 per cent more work per year than the unprofitable ones; did a considerably greater amount of belt work which was formerly done with hired engines, and saved more than twice as much man labor. Thus the satisfied owners not only do more work with their machines, but have made greater reductions both in the amount of man labor which they use, and the expense for engine hire.

INCREASE IN SIZE OF FARM AND REDUCTION IN WORK STOCK.

More than half of the satisfied owners increased their acreage after purchasing their tractors, but only 7 per cent of the dissatisfied owners did so. At the same time the satisfied owners had reduced their work stock an average of 1.8 head, while the dissatisfied owners, with very little increase in acreage, had decreased their work stock by an average of only 0.6 head.

THE PROPER SIZE.

Nine-tenths of the satisfied owners think that their present tractors are the best size for their conditions, while over half of the dissatisfied owners think that some other size would probably be better.

Thus when buying a tractor a farmer should be very sure that he selects the best size for his conditions, and that the material and workmanship of the machine are such that depreciation and repairs will be low. If he intends to run the tractor himself he should make every effort to become a proficient operator, so that repairs, depreciation, fuel consumption, and delays will be reduced to the minimum. If the owner does not intend to operate the tractor himself he should remember that a common farm laborer rarely makes a proficient tractor operator. He must also remember that even the most reliable and economically operated tractor will not prove a profitable investment unless its use will enable its owner to increase his income or reduce his expenses by a sufficient amount to balance the cost of operating the tractor.

